

1           1.     An imaging device comprising:  
2           an optical plate including:  
3                 a base made of an optically transparent material and having an index of  
4     refraction, the base including an array of microstructures along a first surface, and  
5                 a coating deposited on the first surface of the base and forming a surface for  
6     receiving a finger, the coating having an index of refraction that is different from the index of  
7     refraction of the base; and  
8           an imaging system positioned at a second surface of the base to receive light from the  
9     finger at an observation angle measured relative to the finger receiving surface and to form  
10    an image of a fingerprint pattern of the finger based on the received light.

1           2.     The device of claim 1 further comprising a light source at a third surface of  
2     the base to illuminate the first surface of the base.

1           3.     The device of claim 2 in which the third surface is perpendicular to the first  
2     surface.

1           4.     The device of claim 1 in which the index of refraction of the coating is less  
2     than the index of refraction of the base.

1           5.     The device of claim 4 in which each microstructure comprises a surface that is  
2     substantially perpendicular to an observation path such that light from the finger strikes the  
3     microstructure surface at an angle substantially perpendicular to the microstructure surface.

1           6.     The device of claim 1 in which the array of microstructures is defined by a  
2     spatial period that is approximately two times greater than a maximum spatial period of  
3     ridges in an average fingerprint pattern.

1           7.       The device of claim 1 in which the coating comprises silicone.

1           8.       The device of claim 1 in which the base includes a spherically-shaped  
2 reflective surface positioned along a fourth surface that is approximately lateral to the first  
3 surface.

1           9.       The device of claim 8 in which the spherically-shaped reflective surface  
2 collects light from the finger onto the imaging system positioned at the second surface.

1           10.      The device of claim 8 in which the spherically-shaped reflective surface is  
2 formed from a converging mirror.

1           11.      The device of claim 8 in which the spherically-shaped reflective surface is  
2 formed from a diverging mirror.

1           12.      The device of claim 1 in which the imaging system comprises:  
2 an aperture;  
3 an objective at the aperture; and  
4 a detector for receiving light collected by the aperture and the objective to form the  
5 image of the fingerprint pattern.

1           13.      The device of claim 12 in which the imaging system comprises a reflective  
2 surface positioned between the objective and the detector for collecting light from the  
3 objective and for focusing the light onto the detector.

1           14.      The device of claim 12 in which the detector comprises a CCD.

1           15.      The device of claim 12 in which the detector comprises a CMOS sensor.

1           16.     The device of claim 12 in which the aperture defines an aperture beam of light  
2     rays used by the detector to form the fingerprint pattern image.

1           17.     The device of claim 1 in which the index of refraction of the coating is greater  
2     than the index of refraction of the base.

1           18.     The device of claim 17 in which each microstructure comprises a first surface  
2     and a second surface that are positioned such that light striking the first surface at an angle  
3     that is greater than the critical total internal reflection angle for the coating and the base  
4     interface reflects from the first surface and strikes the second surface at an angle that  
5     substantially coincides with a normal to the second surface.

1           19.     A method of imaging a fingerprint, the method comprising:  
2     providing an optical plate that includes:  
3                 a base made of an optically transparent material and having an index of  
4     refraction, the base including an array of microstructures along a first surface, and  
5                 a coating deposited on the first surface of the base and forming a surface for  
6     receiving a finger, the coating having an index of refraction that is different from the index of  
7     refraction of the base;  
8     receiving a finger at the finger receiving surface;  
9     illuminating the finger receiving surface with a light source;  
10    collecting light from the finger receiving surface;  
11    receiving the collected light at an imaging system positioned at a second surface of  
12    the base, the received light traveling at an observation angle measured relative to the finger  
13    receiving surface; and  
14    forming an image of a fingerprint pattern of the received finger based on the received  
15    light.

1           20.     The method of claim 19 further comprising positioning the light source at a  
2     third surface of the base, the third surface being perpendicular to the finger receiving surface.

1           21.     The method of claim 19 in which each microstructure comprises a surface that  
2     is perpendicular to an observation path.

1           22.     The method of claim 19 in which the array of microstructures is defined by a  
2     spatial period that is approximately two times greater than a maximum spatial period of  
3     ridges in an average fingerprint pattern.

1           23.     The method of claim 19 in which collecting light from the finger includes  
2     collecting the light from the finger onto the imaging system.

1           24.     The method of claim 19 in which the imaging system includes an aperture, an  
2     objective at the aperture, and a detector.

1           25.     The method of claim 24 in which receiving light at the imaging system  
2     comprises defining an aperture beam of light rays with the aperture and focusing the aperture  
3     beam of light onto the detector with the objective.

1           26.     The method of claim 19 in which the index of refraction of the coating is less  
2     than the index of refraction of the base.

1           27.     The method of claim 26 in which each microstructure comprises a surface  
2     having a normal that substantially coincides with an observation path such that light from the  
3     finger strikes the microstructure surface at an angle that substantially coincides with a normal  
4     of the microstructure surface.

1           28.     The method of claim 19 in which the index of refraction of the coating is  
2     greater than the index of refraction of the base.

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1           29.     The method of claim 28 in which each microstructure comprises a first surface  
2     and a second surface that are positioned such that light from the finger strikes the first surface  
3     at an angle that is greater than the critical total internal reflection angle for the coating and  
4     the base interface and reflects from the first surface and strikes the second surface at an angle  
5     that substantially coincides with a normal to the second surface.

1           30.     An optical plate for use in an imaging device, the optical plate comprising:  
2             a base made of an optically transparent material and having an index of refraction, the  
3     base including an array of microstructures along a first surface; and  
4             a coating deposited on the first surface of the base and forming a surface for receiving  
5     a finger, the coating having an index of refraction that is different from the index of  
6     refraction of the base.

1           31.     The optical plate of claim 30 in which the base includes a second surface for  
2     coupling to an imaging system and the base transmits light into the imaging system from the  
3     finger at an observation angle measured relative to the surface of the coating.

1           32.     The optical plate of claim 30 in which the index of refraction of the coating is  
2     less than the index of refraction of the base.

1           33.     The optical plate of claim 32 in which each microstructure comprises a  
2     surface that is substantially perpendicular to an observation path such that light from the  
3     finger strikes the microstructure surface at an angle substantially perpendicular to the  
4     microstructure surface.

1           34.     The optical plate of claim 30 in which the index of refraction of the coating is  
2     greater than the index of refraction of the base.

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